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ТЕЙССЕЙР

СЕДИМЕНТАЦИЯ ВЕРХНЕГО ДЕВОНА В МЕСТНОСТЯХ ПОГОРЖАЛА И ВИТОШУВ (ПОЛЬСКИЕ ЦЕНТРАЛЬНЫЕ СУДЕТЫ)

(Резюме)

Свебодзицкая депрессия является сектором когда то обширного седимента-онного бассейна, простиравшегося на рубеже Совиогурского блока и Судетских ледонидов в верхнем девоне и самом нижнем кульме. Верхнедевонские породы этой депрессии представляют собой преимущественно конгломераты, граувакки сланцы, которые не были подвержены метаморфозису. Их мощность доходит 1200 - 1300 м. По мнению автора эти образования следует отнести к дельтовому плексу. Они образовались на скатах дельт погруженных под уровнем моря вно как и на поверхностях дельт, высоко приподнятых над морем, периодически топляемых при высоком уровне воды.

Осаждение верхнедевонских пород в этом районе происходило во время льных тектонических движений (домарсийская фаза по Е. Бедерке). Под влия-ем этих движений наступило постепенное опускание центральной части седи-нтационного бассейна, к которому относится Свебодзицкая впадина. Свидетель-вом этого является накопление мощных толщ осадков в районе этой депрессии верхнем девоне. Опускание происходило неравномерно и было по всей вероят-сти непостоянное. Процесс непостоянного в пространстве и во времени осаж-ния проявлял периоды покоя. В то же время происходило поднятие краев димeнтационного бассейна и его дальнейшего окаймления.

Прежде всего наступило здесь поднятие на обширном пространстве южного ая бассейна, откуда потоки несли наибольшее количество терригенного мате-ала. Край этот был преимущественно сложен совиогурскими гнейсами. Вначале был прикрыт осадками трансгрессии верхнедевонского моря. Одновременно поднятием береговой зоны успевшие отвердеть осадки подвергались эрозии, чем свидетельствует наличие глыб, обломков и гальки верхнедевонских сланцев,

известняков, граувакк и мелкозернистых конгломератов, находимых в конгло-ратах и граувакках верхнего девона Свебодзицкой депрессии.

Макрокластические осадки этой депрессии сложены однако преиму-ственно галькой и обломками пород более древнего метаморфического субстр. Их можно отнести к парагнейсовому комплексу Совиогурского блока, но пре- всего — к литологическим элементам Каледонидов в Судетах. Эти элеме- происходят с высоких горных массивов, воздвигающихся в то время на п-странствах обнятых позже Центрально-Судетской депрессией и северно-чешск впадинами.

Остатки этих массивов подверглись градации и ныне прикрыты мощн покровом осадков младшего палеозоя и мезозойскими образованиями, предст-ленными главным образом осадками верхнего мела.

Кроме палеогеографических и фациальных проблемов автор рассматри- вопрос интраформационных деформаций, выступающих в верхнем девоне на т-ритории села Витошув. Эти деформации, по его мнению, наступали почти од-временно с процессом седиментации. Они образовались вследствие неравном-ного отягощения свежих алевролитов более тяжелыми песками, при чем неод-кратно происходил сплыв обоих слоев в направлении ската морского дна. Явле- это имело место на небольшом пространстве. В дислоцированных осадках выражено синусоидальной складчатостью на границе сланцев и вышележа- граувакк.

TEISSEYRE

UPPER DEVONIAN SEDIMENTATION IN POGORZAŁA AND WITOSZÓW (MIDDLE SUDETEN, POLAND)

(Summary)

STRACT: Upper Devonian palaeogeography and sedimentology is discussed of SE portion of the Świebodzice depression (German: Freiberg). Further evidence given that the Świebodzice depression is a distinct stratigraphic and tectonic it, a fragment of that great Upper Devonian and Lower Culmian synclinorium tending between the gneissic block of the Góry Sowie Mts. (German: Eulenge-ge) and the North Sudeten Caledonides. A description and interpretation are so given of the intraformational corrugations within the shale and greywacke ies of the upper zone of the Hemberg (*Prolobites*) horizon in Witoszów (German: Bőgendorf).

The Świebodzice depression is a distinct geologic unit within the Middle deten, which differs strikingly from its environment not by the composition of stratigraphic column only, but also by its tectonics. It constitutes a fragment the originally much greater synclinorium formed during the Upper Devonian d the lowermost Culm between the gneissic block of the mountains called Góry wie and the North Sudeten Caledonides.

Upper Devonian rocks of the Świebodzice depression have formed under most rticular conditions. They are represented by the molasse of the oldest Variscan ountains elevated in the Middle Sudeten and within some areas of North Bohemia.

In the SE portion of the Świebodzice depression, the Upper Devonian is re-esented by conglomerates, greywackes and shales, with a total thickness of from elve to fifteen hundred meters. In this complex, organogenic limestones occur ceptionally only, in the shape of small lenses (fig. 1 p. 233 of the Polish text). ey yield fossil remains of marine organisms, foremost those of corals, brachio-ds and lime secreting algae belonging to the species *Sphaerocodium zimmermanni* thpl.

Occurrence of marine fauna is also sporadically noted in shales, much less quently in greywackes. The majority of sediments display charred vegetable tritus, sometimes with large fragments of fossil flora.

The shales are often thinly and most rhytmically laminated showing regularly ernating light and darker laminae. Some of the lighter laminae consist mostly quartz flour, while others, the darker ones particularly so, abound in argilla-

ceous minerals and not unfrequently in fine microscopic vegetable detritus. thickness, the laminae here considered range as a rule from one to a few mi meters. Similar but coarser lamination is also sometimes shown in greywackes.

One of the most characteristic features of Upper Devonian rocks in the part of the Świebodzice depression are the changes both in vertical- (time) a horizontal (areal) parameter.

It is rather difficult to correlate stratigraphical units and it is impossi to determine the key horizons in the mentioned succession of beds.

Poor sorting of many conglomeratic beds is another most significant featu of the studied region. Pebbles, cobbles and even boulders occur here. They cemented by a greywacke matrix, in association with more or less angular fr ments of argillaceous shales and metamorphic rocks.

The volume of fine detrital material as against the volume of pebbles var considerably. In many cases, however, detrital material predominates.

On ground of facial features, rocks building up the SE part of the Świe dzice depression may be referred to delta distributaries deposits. Grey silty sha and a major part of the accompanying greywacke deposits have formed on stretching submarine delta slopes. Conglomerates have sedimented partly at entrance of streams into the sea, where they have, to a certain extent, be outwashed and resorted by sea waves.

Nevertheless, owing to markedly poor sorting, as well as to irregular a indistinct bedding, a major part of conglomerates and associated greywackes m be referred to the fluvial facies. In all probability they must have formed wit the topset beds of delta accumulation during seasonal floods.

Marked interest is also entailed by the origin of detrital material wh builds up Upper Devonian deposits of the SE zone of the Świebodzice depressi This is illustrated by a table here below, showing the approximate petrograp composition of medium size conglomerates. The table proves that in the comp sition of medium-grained conglomerates within this zone, 17 percent falls to Upp Devonian pebbles. Pebbles derived from fragments of the Caledonian Range wh was at that time affected by upward movement, and referable to the Camb Silurian, maybe to younger pre-Cambrian, make up fifty percent of conglomerat if considered together with part of the quartz element. Material derivative fro the Góry Sowie Mts. paragneissic block, viz. gneisses, granites, pegmatites a another portion of the quartz, contribute 30 percent only.

In the author's opinion the Caledonian material has been derived neith from Góry Kaczawskie Mts. (German: Bober-Katzbachgebirge), nor from th prolongation in the fore-Sudeten block, since it is strongly different from roc occurring there. Further, the SE portion of the Świebodzice depression is separat from the Góry Kaczawskie Mts. and from their prolongation by a zone of Upp Devonian deposits without conglomerate beds.

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Table 1

able showing percentage petrographic composition of Upper Devonian conglome-
ites in the SE portion of the Świebodzice depression, from field data obtained by analysing 2700 medium-size pebbles (20-200 mm.)

o	*kind of rock*	*mean perc.*	*range of perc.*	*provenance of pebbles*
1	compact limestones, frequently with Upper Devonian marine fauna	1.3	0-40	
2	grey shales, silty & argillaceous	3.5	0-44	Upper Devonian rocks
3	greywackes, sandstones, fine grained conglomerates	11.9	0-52	
4	quartzites, quartzite schists	31.6	0-72	
5	lydites, siliceous shales	0.2	0-2	
6	various schists & phyllites	1.3	0-7	
7	diabases	10.1	0-40	Cambro-Silurian, in part probably also younger Pre-Cambrian rocks
8	green schists	1.3	0-12	
9	palaeoporphyries, keratophyres & porphyroids	2.0	0-14	
0	quartz, mostly milky	9.2	1-47	
1	various Góry Sowie Mts. gneisses	21.0	0-79	rocks of the gneissic Góry Sowie Mts. block
2	granites & pegmatites	3.2	0-13	
3	gabbro	0.5	0-8	various rocks
4	other or indeterminate rocks			

The writer's view is concurrent with that of D. Pawlik (7)* in suppos that in Upper Devonian times streams, responsible for the infilling of the SE po tion of the Świebodzice depression, were flowing from the south. The Caledon material carried by these streams had been eroded from mountains, then be upheaved within the Middle Sudetic trough, probably also in the adjacent zones the North-Bohemian depression. In the lower parts of the valleys that mater became associated with fragments of rocks building up the gneissic block of Góry Sowie Mts.

The perfect sphericity of numerous quartzite pebbles in deposits of fluv character speaks in favour of their transport over a distance of at least 10-20 k

Upper Devonian rocks within the SE portion of the Świebodzice depress were deposited during tectonic movements. The floor of the Świebodzice sync norium was subject to gradual though not uniform subsidence. This is testified great thickness of the delta beds, by the author estimated to range in the investigat region from twelve to fifteen hundred meters. German writers quote this figu at eleven hundred meters *(4)*.

There were also contemporaneous upward movements in the surroundi anticlinorial areas supplying detrital material (pre-Marsial phase, E. Bederke D. Pawlik, 7). Large marginal belts of the sedimentation basin, originally cover by Upper Devonian deposits, emerged from the sea already during the earlier pa of Upper Devonian period. The maximum activity, however, of the upward mov ments is referable to the lower part of the Hemberg (*Prolobites*) horizon, the ti of the formation of greywackes and conglomerates (see table I, facing p. 228 of t Polish text) which built up the hills of Mrownica (German: Ameisen-Berg), Lipi (Lindenberg) and Witosz (Grenz-Berg). Nevertheless, it should be emphasized th pebbles and fragments of Upper Devonian rocks are observable in conglomerat over- and underlying the considered stratigraphic zone.

It is, therefore, the author's opinion that within the Świebodzice synclinoriu and in adjacent areas, tectonic movements continued all through Upper Devoni times, though with varying degree of intensity.

In the final chapter the author is concerned with intraformational corrugati phenomena observable in the shale and greywacke series of the upper Hembe (*Prolobites*) horizon of Witoszów. He describes the corrugations as phenomena n bearing any features of tectonic deformations, and as penecontemporaneous wi their sedimentation processes. For their development he judges responsible t uniform load made to bear on fresh silts by the heavier sands often causing t flow of both these layers in the direction of the submarine slope. No considerab space was involved in the flowage.

* Figures in *italics* in brackets refer to the literature quoted in the Poli text.

The corrugation is by far the most intensive on the silt-sand boundary. The erturbations disappear totally on the top- and undersurface of both beds. In ıses, where the perturbations are moderately developed, the boundary of the orrugated strata form a sequence of sinusoidal folds. But the more common cases iow an intricately complicated pattern in cross section.

The sandy stratum was rent to pieces while sinking unevenly in the far ore liquid silt, bearing a considerable quantity of colloidal material and being versaturated with water. Particle by particle mixing of both sediments has taken ever place. The movements were rather fluidal, the masses moved as a kind of conti-ıum. The displacements ensued along the planes of bedding, which were curved nd intricately deformed. Figs. 5-9, p. 244-247 of the Polish text illustrate several atterns of these corrugations.

Finally the author emphasizes that his article deals with but a distinctly inor part of the palaeogeographic and sedimentologic problems connected with ıe Sudeten Upper Devonian deposits. Their development is subject to cardinal egional differentiation. This depends foremost on tectonic factors contemporaneous · penecontemporaneous with sedimentation.

The Upper Devonian of the Świebodzice depression is a formation of synoro-enic character; the epicontinental Upper Devonian deposits from the vicinity of owa Ruda (German: Neu-Rode) and Kłodzko (Glatz) may be considered as their ounterparts *(1, 2)*. The former of these regions is one of detrital deposits of great ıickness, never under 1200-1500 m.; the other region is mostly represented by cal-ıreous rocks, greatly inferior in thickness.

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DESCRIPTION OF FIGURES IN THE POLISH TEXT

Fig. 1 (p. 233)

pper Devonian outcrop in Mokrzeszów (abandoned quarry in a wood 1 km. to the south of the SW periphery of the village)

greywackes with grey shale intercalations; *b* silty shales with mica, dark grey with bluish tint and scarce pyrite crystals; non-uniform cleavage with iron and alum ains on fissures; very few fine greywacke intercalations; *c* shales as above but ithout greywackes; *d* black shales, somewhat calcareous, occasionally with distinct ora remnants; fairly numerous pyrite crystals occurring in shales; limonite-alumous ains on cracks, platy cleavage; *e* shales as above with intercalations of black con-etional limestones; *f* grey limestones, non-uniformly platy with abundant coral mnants, also frequently *Sphaerocodium* and shells of brachiopods; black shales tercalate the limestones; *g* ashy limestone; *h* grey-green and black shales, showing rong tectonic crushing; *i* dark grey and black limestones (malodorous), unevenly

bedded with irregular lens-like black shale intercalations. Lenses of corals frequen[t] occurring in limestone; also *Sphaerocodium*, brachiopods and segments of crino[ids]

Fig. 2 (p. 234)

a resting on silty shales *b* intercalated by fine-grained greywacke *c*. Silty sha[les] sometimes distinctly arenaceous; greywackes with frequent ripple marks on upp[er] surfaces; these ripple marks mostly asymmetric, with steeper northern slope

Fig. 3 (p. 238)

Thick-bedded conglomeratic Upper Devonian greywackes associated with bloc[ks] and fragments of Devonian shales in Pogorzała. This deposit has been formed d[ue] to subsidence of fresh delta distributaries deposits on delta slope

Fig. 4 (p. 241)

Illustration of intraformational erosion within Upper Devonian rocks in the Pogorza[ła] area

1 greywackes, somewhat clayey and shaly; *2* conglomeratic greywacke; *3* silty shal[e] with thin intercalations of compact fine greywackes

Fig. 5 (p. 242)

Intraformational corrugations at Witoszów

illustrating moderately disturbed beds

a fine-grained, somewhat clayey greywacke, indistinctly laminated; *b* grey sil[ty] shale; *c* non-uniformly grained greywacke, mostly coarse-grained, sometimes fin[e] conglomeratic; *d* silty shales, strongly arenaceous; *e* fine-grained greywacke, i[n]distinctly laminated

Fig. 6 (p. 243)

Intraformational corrugations at Witoszów

illustrating strongly disturbed beds with clearly shown secondary fluidal texture

a greywacke-silty shale; *b* fine-grained silty greywacke; *c* non-uniformly graine[d] greywacke, mostly coarse-grained; *d* greywacke-silty shales, sporadically showi[ng] a distinct fine lamination; *e* dark grey silty shale

Fig. 7 (p. 244)

Intraformational disturbances at Witoszów

a grey silty shale, finely laminated; *b* fine-grained silty greywacke; *c* coars[e-] grained greywacke grading into fine-grained conglomerate; *d* grey silty, fine[ly] laminated shale

Fig. 8 (p. 246)

Formation of greywacke knots in silty shales before solidification of deposits

Principal development stages of plastic deformation: *a* primary folding; *b* dee[p] vertical penetration of the two deposits; *c* greywacke rim tapering and cut off fro[m] its bedrock through the pressure of silty material

Fig. 9 (p. 247)

Intraformational corrugations at Witoszów

ine-grained greywacke, occasionally showing indistinct cross-bedding; *b* sandy y shale; *c* greywacke-silty shale; *d* coarse-grained greywacke, in parts conglo- ratic; *e* fine-grained compact greywacke; *f* grey silty shale; *g* fine-grained thinly aminated compact greywacke; *h* grey silty shale; *i* unevenly grained greywacke

Fig. 10 (p. 249)

Intraformational corrugations at Witoszów

a conglomeratic greywacke; *b* silty greywacke

rows indicate movements of unsolidified sediment particles during development of intraformational corrugations

Table I (facing p. 228 of the Polish text)

Geologic sketch map of the SE portion of the Swiebodzice depression

iantle of Pleistocene beds; *2* gneissic conglomerate (the Culm from Książ); Upper vonian: *3* silty shales, *4* greywackes and conglomerates, *5* organogenic limestones, stly of reef-origin; *6* greenstone shales and schistose keratophyres; *7* diabases; aragneissic Góry Sowie Mts. complex; *9* faults (partly beneath the Quaternary series); *10* sites of occurrence of Upper Devonian fauna

КЕЛЯН

РАТИГРАФИЯ ВЕРХНЕГО ОРДОВИКА В СВЕНТОКРЖИСКИХ ГОРАХ

(Резюме)

Автор дает обзор стратиграфии верхнего ордовика в Свентокржиских Горах, енно в Бржезинках на северном склоне Лысогорского кряжа и в местностях лесе и Ставы южнее Лагова. Она проводит сопоставление найденных здесь оев с соответствующими образованиями Швеции и Чехословакии и приходит следующим заключениям:

1° На северном склоне Лысогорского кряжа верхний ордовик представлен оными граптолитобыми сланцами горизонта с *Pleurograptus linearis*, постепен- переходящими кверху в светлые алевролиты с трилобитами. Эти породы яв- отся эквивалентом горизонтов с *Dicellograptus complanatus* и *D. anceps*. Они ше всего были исследованы в профиле в Бржезинках, где мощность их до- гает 80 м.

2° Фауна алевролитов Бржезинок, представленная приблизительно 60 вида- трилобитов, весьма сходна с фауной красных алевролитов с *Tretaspis* и сло- с *Staurocephalus* Швеции, в особенности Скании, а также с фауной слоев фралув Двур Чехословакии.

3° В профиле Бржезинки между образованиями ордовика и силура суще- вует перерыв частично тектонического происхождения, который обнимает верх- ю часть горизонта с *Dicellograptus anceps* и весь горизонт с *Akidograptus* *minatus*, включая дальманитиновые слои.

4° В профиле ордовика в Залесе представлены не все его горизонты, во- еки существующему до сих пор мнению (*6*)*, но только нижний ордовик (тре- док и частично арениг), образованный песчаниками, на которых залегают даль- нитиновые слои. Перерыв обнимает по крайней мере лландейльский, карадок- ий и ашгильский ярусы.

5° Состав фауны трилобитов дальманитиновых слоев Свентокржиских Гор вершенно отличается от фауны трилобитов верхне-ордовикских светлых але- олитов Бржезинок.

6° Дальманитиновые слои окрестностей Лагова в Свентокржиских Горах офили в Залесе и Ставы) проявляют большое сходство с дальманитиновыми оями в Скании. Повыше этих слоев лежат согласно граптолитовые сланцы

* Цифры курсивом в скобках относятся к списку литературы в польском сте.

с *Climacograptus scalaris normalis*, являющиеся эквивалентом горизонта с *Glyp-graptus persculptus*, а еще выше сланцы с *Akidograptus acuminatus*.

7° Дальманитиновые слои в Свентокржиских Горах представляют осадки ...лее мелководные чем верхне-ордовикские алевролиты Бржезинок. В конце ор...вика на территории Свентокржиских Гор наступило обмельчение моря. Не в...яснен вопрос, привело ли это обмельчение к образованию суши; нигде в пу...тах выступания дальманитиновых слоев в Свентокржиских Горах не констати...вано в их подошве наличия базального конгломерата или иных признаков тра...грессии.

8° Возраст дальманитиновых слоев пока что еще не установлен. В Шве... дальманитиновые слои в последнее время причислены к ордовику (Янусс... 12). Вопрос их возраста может быть решен лишь тогда, когда фауна этих сло... будет исследована во всех пунктах своего выступания.

FIA KIELAN

ON THE STRATIGRAPHY OF THE UPPER ORDOVICIAN IN THE HOLY CROSS MTS.

(Summary)

STRACT: Upper Ordovician series, consisting of black graptolitic shales and ht trilobite-bearing mudstones, striking along the northern flank of the Łysogóry nge within the Holy Cross Mts., are described. The trilobite fauna there, with re than sixty species, is compared with the Upper Ordovician faunas of Sweden d Bohemia. A section of the Ordovician exposed at Zalesie near Łagów is shown represent the Tremadocian and Arenigian only, above which rest the *Dalmanitina* beds. The age of *Dalmanitina* beds is discussed.

The Upper Ordovician series in the Holy Cross Mts. were discovered by the e J. Czarnocki *(6, 7, 8)**. In 1951 Czarnocki handed over to the present author part of his collections of Upper Ordovician trilobites, which escaped destruction ring the war, from Wólka and Brzezinki in the Holy Cross Mts. In 1952 and 1953 writer repeated the field work at the fossil-bearing sites mentioned here and o at Zalesie and Stawy near Łagów; financial support for the cost of field work s received from the Polish Geological Institute. The trilobites collected are to m the basis of a monograph. The present paper is only a preliminary report on the atigraphy of the Upper Ordovician in the Holy Cross Mts.

Laboratory work has been carried out since 1954 in the Palaeozoological stitute of the Polish Academy of Sciences in Warsaw, under the supervision of of. R. Kozłowski. to whom the writer wishes to express her deep appreciation his continued assistance. All graptolites mentioned in this paper were identified Mr. H. Tomczyk from Kielce, to whom the writer also expresses her gratitude. of. P. Thorslund, University of Uppsala, has helped the writer by lending her manuscript of his paper *(35)*. Especially deep appreciation is expressed by the iter to Dr. V. Jaanusson, University of Uppsala, for the loan of the manuscript his recent paper *(12)*, for reading the manuscript of the present paper and for lpful advice and criticism.

The Upper Ordovician series in the Holy Cross Mts. strikes along the northern nk of the Łysogóry Range with sites of occurrence noted at Kajetanów, Brzezinki, ólka and Jeleniów (see fig. 1). Of these the Ordovician strata noted at Brzezinki d Wólka are most easily accessible. During 1952 and 1953 the writer has collected

* Figures in *italics* in brackets refer to the literature quoted at the end of the lish text. Pages of drawings, plates and tables refer also to the Polish text.

fossils at these two localities. At Wólka the Ordovician lies unconformably with the zone of dislocation. Most of the detailed information on the stratigraphy of t Ordovician series has been obtained from the Brzezinki section, where Ordovici rocks grade from black graptolitic shales (zones of *Dicranograptus clingani* a *Pleurograptus linearis*) into light trilobitic mudstones. Light mudstones up to 80 thick consist of marls secondarily decalcified within the area of weathering. Fro these series the writer has collected and identified more than sixty species of trilobit of which about thirty percent are new species. These light mudstones have bee subdivided by the writer into three horizons, here referred to as lower, middle an upper beds. In the lower beds with a thickness of 25 m. and resting on black grapto litic shales, trilobites make their appearance locally in some layers only. Extrem faunal abundance is characteristic of the middle zone of the profile, 32 m. in thick ness. The upper zone, which is 23 m. thick, consists of completely unfossilifero rocks. The following trilobites have been yielded by the lower zone of the profi (see plates in the Polish text): *Tretaspis granulata bucklandi* (Barr.), *Novaspis* s (species nova), *Trinodus tardus* (Hawle & Corda), *Cyclopyge* sp. (species nova), *Ca mon mutilus* Barr., *Raphiophorus globifrons* (Olin), *Raphiophorus gratus* (Barr. *Lonchodomas portlocki* (Barr.), *Dindymene ornata* Linnarsson, *Dindymene pulch* Olin, *Pseudosphaeroxochus laticeps* (Linnarsson), *Pterygometopus recurvus* (Ol. and some others. In the collection of fossils from this part of the profile, many of t species here mentioned are represented by single specimens only. *Dindymene pulch* Olin and *Pseudosphaeroxochus laticeps* (Linnarsson) are the only species cited he which have not been detected in the middle zone. In addition to species passi from lower beds, those middle beds, in which trilobites are so numerous both species and in individuals, also yield the following species (see plates): *Staurocephal clavifrons* Ang., *Phillipsinella parabola* (Barr.), *Pseudobasilicus nobilis* (Barr.), *Cera rus intermedius* Kielan, *Raphiophorus tenellus* (Barr.) and many others.

The assemblage of trilobites found at Wólka in general corresponds to th at Brzezinki, although some of the rarer species of trilobites have been record from Brzezinki only. It is worth mentioning that one wax cast (see plate II, fig. of *Tretaspis seticornis* (His.), not recorded from Brzezinki, has been collected Wólka. The light mudstones of Wólka have also yielded some specimens of graptolit including: *Orthograptus truncatus* Lapw., *Plegmatograptus nebula* Elles & Woo *Climacograptus* cf. *scalaris miserabilis* Elles & Wood and *Dicellograptus* sp.

On the whole, the beds above the *Pleurograptus linearis* zone in the Ho Cross Mts. appear to contain a faunal assemblage distinct from that of Great Brita *Diacalymene marginata* Shirley is absent from the fauna both of Wólka a Brzezinki and the close correlation of the beds here with lower Ashgillian beds England (represented by *Diacalymene marginata* beds) is difficult. It should be me

ed, however, that King and Williams *(18)* assert that correlation of *Diacalymene ginata* beds recorded from various districts of Great Britain meets with certain culties and has not so far been completed. On account of the faunistic differ-s between the Upper Ordovician faunas of Great Britain and Poland, an exact elation of the beds studied in the present paper with those included in Ashgillian reat Britain is difficult.

The Upper Ordovician fauna of the Holy Cross Mts. on the other hand shows close similarities to Swedish (especially Scanian) and Bohemian faunas and is, ict, in certain respects intermediate between them. The lower beds of the Brzezin- ection may be regarded as an equivalent of the Red *Tretaspis* mudstone, and the dle beds as equivalent to the *Staurocephalus* beds of Sweden. The lower and dle beds of the Brzezinki section, taken together, may be regarded as equivalent ne Kralův Dvůr beds of Bohemia. Of the sixty or so species of trilobites yielded he light mudstones of the Holy Cross Mts., 24 have been recorded from the *urocephalus* beds of Scania and 20 from the Kralův Dvůr beds of Bohemia, ough some of these species are represented in the Holy Cross Mts. by distinct species. The uppermost part of the Brzezinki section is unfossiliferous and its elation cannot be determined at present.

Graptolitic shales with *Orthograptus vesiculosus* rest on the light Brzezinki stones. The break noted here, which is partly of tectonic origin, spreads over the rmost Ordovician: the summit of the zone of *Dicellograptus anceps* and the re zone of *Akidograptus acuminatus,* including the *Dalmanitina* beds.

Czarnocki *(6)* described in 1928 the Ordovician section of Zalesie near Łagów ncluding the complete series of Ordovician sediments. The thickness of the le Ordovician series is recorded by that author as not exceeding 30 m. Field arch done by the present writer on the section exposed at Zalesie and Stawy r Bardo (see fig. 1), and the identification of the trilobite fauna collected there, e led to the conclusion that the Zalesie profile does not represent all the Ordo-an horizons, but the lower Ordovician series only (Tremadocian and also partly nigian), consisting of sandstones on which rest the *Dalmanitina* beds. The break e involves the Llandelian, Caradocian and Ashgillian. The development of the *nanitina* beds in these sections is similar to that of Scania. In the lower part of the *nanitina* beds in Poland occurs *Dalmanitina* cf. *olini,* but some specimens of *nanitina mucronata* has been recorded, together with *D. olini,* in an upper layer his part of the section. In the middle part of the *Dalmanitina* beds occurs *Dal-itina mucronata* together with other trilobite species, the uppermost layer of *nanitina* beds has yielded *Dalmanitina mucronata* and *Brongniartella* cf. *platy-s. Brongniartella* cf. *platynotus* is represented in the collection from Zalesie wo specimens only. The assemblage of trilobite species in the zone of *Brogniar-* appears to be very similar to that from the middle beds of *Dalmanitina mu-*

cronata. Troedsson divided the *Dalmanitina* beds in Scania at first *(36, 37)* into zones and later *(38, 39)* into three zones: 1. lower zone of *Dalmanites eucentr* (*Dalmanitina olini*), 2. middle of *D. mucronata,* and 3. upper of *D. mucronata* *Homalonotus platynotus (Brongniartella platynotus).* But *Dalmanitina mucro* appears in Sweden first already in the *Staurocephalus* beds, its use, therefore, a index fossil for the upper part of the *Dalmanitina* beds seems to be inadequate. M recently in Sweden, Thorslund *(35)* has not used Troedsson's division of the *Dalm tina* beds but has treated them as a single series. The present writer agrees w Thorslund's opinion, believing that the present state of knowledge about the *Dal nitina* beds in Sweden and in the Holy Cross Mts. makes it difficult to divide th into faunistic zones, although it may be stated that there are close similarities in t development in Scania and the Holy Cross Mts. The similarity of the sections scribed here to those from Sweden applies also to the graptolitic shales lying at summit of the *Dalmanitina* beds, since in the Stawy section, as in Vestergötla *Climacograptus scalaris normalis* and *Cl. scalaris miserabilis* occur only at the ju tion with *Dalmanitina* beds, whilst *Akidograptus acuminatus* is recorded from 4 m. higher up. *Cl. scalaris normalis* and *Cl. scalaris miserabilis* do not occur Vestergötland (Waern, *40*) in beds higher than the zone of *Glyptograptus perscu tus*. It seems therefore that the lowermost layers of the Stawy graptolitic sha yielding these two species, may be referred to the zone of *Gl. persculptus* of G Britain.

It was difficult to identify the break in the Zalesie section owing to absence of an angular unconformity between the Lower Ordovician series the *Dalmanitina* beds. Troedsson *(38, 39)* suggested that there is a stratigraph break between the Upper Ordovician and the *Dalmanitina* beds in Scania. The there became shallower towards the close of the Ordovician period and ultimately emergence occurred in this region. In that author's opinion the *Dalmanitina* bed Scania are referable to the Silurian — they form the basal sediment of the Silu transgression, being closely associated with overlying *Rastrites* beds. In discuss Troedsson's opinion, it should be mentioned that in other sites of occurrence *Dalmanitina* beds in Sweden (Vestergötland and Vesterbotten) there are two str graphical breaks, above and below the *Dalmanitina* beds (Kautsky, *15*, p. 121).

The *Dalmanitina* beds in Vestergötland have been referred by Waern *(40* Silurian but this view has met with criticism by Jones *(14)* who states (l. c. p. that: „...in comparison with British sections the Ordovician-Silurian boundary sh be drawn between *Rastrites* beds and *Dalmanitina* beds". Likewise Henningsm *(11)* places the Ordovician-Silurian boundary above the *Dalmanitina* beds, corre ing them with zone 5b of the Oslo Region.

This view is strongly supported by Jaanusson *(12)*, who believes that t are two indications of the Ordovician age of *Dalmanitina* beds. They are:

Table of correlations of the Upper Ordovician beds in S

	Graptolitic succession in Great Britain	Sweden		
		Scania	Vestergötland	Brzezinki
LLANDOVERY	Zone of *Orthograptus vesiculosus*	*Orthograptus vesiculosus*	*Orthograptus vesiculosus*	*Orthograptus vesiculosus*
	Zone of *Akidograptus acuminatus*	*Akidograptus acuminatus*	*Akidograptus acuminatus*	H i a t u s (partly of tecto origin)
	Zone of *Glyptograptus persculptus*	*Climacograptus scalaris normalis*	*Climacograptus scalaris normalis* H i a t u s	
?	Shelly facies	*Dalmanitina* beds	*Dalmanitina* beds	
UPPER ORDOVICIAN		H i a t u s	H i a t u s	
	Zone of *Dicellograptus anceps*	*Staurocephalus* beds	*Staurocephalus* beds	L i g h t m u d s t o n e s: Upper unfossill beds Middle beds with *aspis granulata bu di, Staurocephalu vifrons, Phillip parabola, Loncho portlocki, Trinodu dus* and many o
	Zone of *Dicellograptus complanatus*	Mudstones with „*Niobe*“ *lata* and *Dicellograptus complanatus*	Red *Tretaspis* mudstones	Lower beds with *aspis granulata landi, Dindymene ta, Pseudosphaero laticeps, Orthog truncatus* and *P tograptus neb*
	Zone of *Pleurograptus linearis*	Black graptolitic shales with *Pleurograptus linearis* and *Climacograptus styloideus*	Green *Tretaspis* mudstones Black *Tretaspis* shales Slandrom limestone	Black graptolitic s with *Climacograp styloideus*

1° *Dalmanitina olini* Temple occurs in the lower part of the *Dalmanitina* ls in Sweden, but is found in Great Britain (Temple, 33) only in the Ashgillian.

2° The graptolitic fauna above the *Dalmanitina* beds in Vestergötland must referred to the lowest Llandovery zone of *Glyptograptus persculptus*, although *persculptus* has not yet been found in Sweden.

Regarding the age of the uppermost part of the *Dalmanitina* beds Jaanusson writes: „Für eine genaue Korrelation des oberen Teiles der *Dalmanitina*-Schichten len gegenwärtig noch sichere Anhaltspunkte, und diese Frage kann erst nach er Bearbeitung der Fauna dieser Schichten endgültig entschieden werden. Da r die faunistischen Unterschiede zwischen den Schichten mit *Dalmanitina olini* l dem oberen Teil der *Dalmanitina*-Schichten nach den bisherigen Angaben gering d, dürfte es am wahrscheinlichsten sein, dass die gesamten *Dalmanitina*-Schichten in Schweden zum Ashgill gehören und daher als oberstes Ordovizium betrachtet rden müssen".

It is also of interest that in the Holy Cross Mts. the faunal assemblage of the *manitina* beds is quite distinct from that occurring in the light mudstones of ezinki. Of the sixty trilobitic species recorded from the light Brzezinki mudstones, y two have been detected by the writer in the *Dalmanitina* beds; these are: *llipsinella parabola* (rare) and a new species from the genus *Whittingtonia* Prantl Přibyl, represented by one specimen of a separate sub-species. In the *Dalmanitina* s the absence is noted of representatives of the genus *Tretaspis*, an index form m the Ordovician strata, yielded in thousands from rocks at Brzezinki and Wólka; nbers of the genera *Cyclopyge*, *Trinodus* and *Dindymene* characteristic for Up- Ordovician strata are also absent. The trilobite fauna of the *Dalmanitina* beds, sisting of species from the families: Odontopleuridae, Proetidae and Otarionidae hout any tretaspids, reveals a different assemblage from that of the light mudnes. These differences may be partly due to different ecological conditions, — more sandy *Dalmanitina* beds have probably been deposited in shallower water n the light Brzezinki mudstones. Nevertheless in the opinion of the present ter the age of the *Dalmanitina* beds remains an open question and its solution uires thorough faunal investigation in all occurrences of the *Dalmanitina* beds; s in this paper (see table of correlation) they are provisionally not included Ordovician and Silurian beds.

At the close of the Ordovician the sea of the Holy Cross Mts. became shaler as in Sweden, but no evidence is available that a similar emergence occurred. basal conglomerate rocks or other signs of transgression have been detected at base of the *Dalmanitina* beds within the Holy Cross Mts. Stubblefield (32, p. 64) es that in the Lake District of England, in North and Central Wales and Ireland *manitina mucronata* has been identified from assemblages of Upper Ordovician na occurring in strata referable to uppermost Ashgillian. In South Wales-

Haverfordwest (Reed, *28*, p. 537) and in Scandinavia (Troedsson, *39*) this species occu in a Silurian assemblage. „If these specific and stratigraphic identifications a correct — writes Stubblefield (*32*, p. 64) — one might visualize a migration sout wards and eastwards from North Wales and Lake District at the close of Ashgilli times". Temple *(33)* assumes that *Dalmanitina socialis* (Barrande), occurring Bohemia earlier than in the equivalent of the *Staurocephalus* zone, may be possib ancestral to *D. mucronata*. He states (l. c. p. 28): „As the latter (*D. mucronata*) h been recorded from Poland in beds which are probably of the same age as t Brachiopod beds of Sweden, it is possible to envisage a migration of the *D. mucr nata* stock from Bohemia through Poland to Sweden and Northern England". Fa nistic evidence obtained in the Holy Cross Mts. seems, however, not to confir Temple's conclusion. *Dalmanitina mucronata* appears in Sweden and Great Brita in *Staurocephalus* beds, although it was not yielded by the beds of the same a in Poland, where it appears only in the upper part of the *Dalmanitina* beds. It therefore possible to accept in part Stubblefield's conclusion, assuming, howeve the possibility of an eastward and southward migration of this species from Gre Britain and Sweden to Poland at the close of the Ordovician. This *Dalmanitina mu cronata* assemblage of trilobite fauna has not, however, spread into Bohemia. Th the origin of *Dalmanitina mucronata* remains in doubt.

Palaeozoological Institute
of the Polish Academy of Sciences
Warszawa, March 1956

DESCRIPTION OF FIGURES IN THE POLISH TEXT

Fig. 1 (p. 254)

Schematic geologic map of the middle part of the Holy Cross Mts. 1 : 300 000
(after J. Samsonowicz, *32*)

1 Cambrian, *2* Ordovician and Silurian, *3* younger formations, *4* faults

CONSPECTUS

Pl. I

Tretaspis granulata bucklandi (Barrande)

— Nearly complete individual — Wólka, Upper Ordovician, light mudstones × 1,5

— Cephalon — Brzezinki, Upper Ordovician, light mudstones, middle beds × 2,5

— Cephalon, wax cast — Wólka, Upper Ordovician, light mudstones × 2

Trinodus tardus (Hawle & Corda)

— Pygidium — Wólka, Upper Ordovician, light mudstones × 6

— Cephalon — Brzezinki, Upper Ordovician, light mudstones, middle beds 5

— Complete individual — Ibidem × 5

Carmon mutilus (Barrande)

— Complete individual — Wólka, Upper Ordovician, light mudstones × 3

specimens except fig. 3 whitened

Pl. II

Dindymene pulchra Olin

— Nearly complete individual — Brzezinki, Upper Ordovician, light mudstones, lower beds × 3

Pterygometopus recurvus (Olin)

— Cephalon and thorax — Brzezinki, Upper Ordovician, light mudstones, middle beds × 3.5

— Cranidium — Ibidem × 4

— Complete individual — Ibidem × 3

Tretaspis seticornis (Hisinger)

— Part of cephalon, wax cast — Wólka, Upper Ordovician, light mudstones × 3

Pseudobasilicus nobilis (Barrande)

— Complete individual — Brzezinki, Upper Ordovician, light mudstones, middle beds × 2.5

specimens except fig. 5 whitened

Pl. III

Dindymene ornata Linnarsson

— Cephalon — Brzezinki, Upper Ordovician, light mudstones × 5

— Complete individual — Brzezinki, light mudstones, middle beds × 5.5

Staurocephalus clavifrons Angelin

— Cephalon — Wólka, Upper Ordovician, light mudstones × 5

— Complete individual — Brzezinki, Upper Ordovician, light mudstones, middle beds × 2.5

Carmon mutilus Barrande

— Complete individual, natural negative impression — Brzezinki, Upper Ordovician, light mudstones × 2.7

— Complete individual — Brzezinki, Upper Ordovician, light mudstones, middle beds × 3

Lonchodomas portlocki (Barrande)

— Complete individual — Brzezinki, Upper Ordovician, light mudstones, middle beds × 5

specimens whitened

Pl. IV

Phillipsinella parabola (Barrande)

1 — Complete individual with two cephalons, natural negative impression — Brzezinki, Upper Ordovician, light mudstones

2 — Complete individual — Brzezinki, Upper Ordovician, light mudstones, middle beds

Dalmanitina mucronata (Brongniart)

3 — Pygidium — Zalesie, *Dalmanitina* beds

4 — Cranidium — Stawy, *Dalmanitina* beds

5 — Cephalon — Ibidem

Dalmanitina cf. *olini* Temple

6 — Pygidium — Stawy, *Dalmanitina* beds

7 — Pygidium — Ibidem

8 — Cranidium — Ibidem

All specimens whitened

I. КОТАНЬСКИ

К СТРАТИГРАФИИ И ПАЛЕОГЕОГРАФИИ . ВЕРХНЕТАТРАНСКОГО КЕЙПЕРА В ТАТРАХ

(Резюме)

В кейпере верхнетатранской серии до сих пор описаны только красные зеленые сланцы, песчаники и конгломераты с редкими прослойками доломи- Разрез в Долинке Смытней показывает над сланцево-конгломератовой серией егание мощной (свыше 100 м.) серии желтых, местами мергелистых доломитов. нцево-конгломератовая серия отнесена временно к карнийскому ярусу, серия омитов — к норийскому. Из факта, что в пункте Червонэ Жлебки в Долине ановой весь кейпер представлен в сланцево-конгломератовой фации, следует, в этот период в седиментационном бассейне серии Комины Тыльковэ должна а иметь место сильная фациальная дифференциация. В разрезе Червонэ эбки кейпер связан седиментационно с ладинским ярусом. В Долине оловской и во всей западной окраине Татр средний триас отсутствует. может свидетельствовать об эрозии и денудации во время карний- о яруса. В норийском — вся эта зона была снова занята морем. Сланцево- гломератовые слои кейпера в пункте Червонэ Жлебки седиментационно свя- ы с томановскими слоями рэтского возраста. В Долине Хохоловской морской ик связан седиментационно с морским рэтом и лейасом. В Долинке Смытней ас залегает абразионно на норийском ярусе. В его подошве залегает клифовая ччия, сложенная из больших глыб желтых норийских доломитов. Из этого дует, что в рэте эта зона была повидимому сушей. В серии Червонэ Верхи евонт осадки кейпера вполне отсутствуют. В карнийское время здесь была а с развивавшейся денудацией, которая устранила высшие части среднего иса и достигла анизийский ярус. Новая трансгрессия наступила в норике. омки норийских доломитов обнаружены в осадках трансгредирующего доггера. ункте Женды возле горы Цемняк наблюдается небольшое угловое несогласие ду норийскими слоями и трансгредирующими на них байосскими. Эти движе- имели место в рэту, — они относятся к древнекиммерийской фазе альпий- о орогенезиса.

ZB. J. KOTAŃSKI

STRATIGRAPHIC AND PALAEOGEOGRAPHIC PROBLEMS IN THE HIGH-TATRIC KEUPER

(Summary)

ABSTRACT: Marked facial differentiation has been recorded within the high-Tat Keuper series. Denudation has been at work in many places during the Carnia The shaly-conglomeratic facies was predominant then while during the Nori dolomites of considerable thickness formed too. Previous to the Lias but after t Keuper distinct traces of orogenic movements on no great scale were observal within the high-Tatric series.

Only red and green shales, sandstones, conglomerates and rare dolom intercalations have thus far been recorded from the high-Tatric Keuper series. seen from a profile in the Smytnia Valley, this shaly-conglomeratic series is ove laid by thick strata of yellow, occasionally marly dolomite, more than 100 m. thickness. The shaly-conglomeratic series has been tentatively referred to t Carnian, the dolomite series — to the Norian. Since, within the Czerwone Żle in the Tomanowa Valley, the complete Keuper series is represented in the sh conglomerate facies, strong facial differentiation must have existed at that ti in the Kominy Tylkowe sedimentation area. Sedimentary connection is show between the Keuper and Ladinian series in the Czerwone Żlebki. In the Choch łowska Valley and in the west marginal areas of the Tatra Mts. Middle Trias beds are absent, while Norian shales and dolomites rest directly on Werfenian shal This seems to suggest Carnian erosion and denudation. Carnian rocks within t sedimentation area of the Czerwone Wierchy and Giewont series have also e perienced this erosion. It has reached here down to Anisian deposits which are r presented in this series, Ladinian deposits being completely absent. During t Norian, the entire high-Tatric area here suffered marine transgression. Within t Smytnia Valley, the Norian age is assignable to a mighty dolomite series, also red shales and conglomerates in the Czerwone Zlebki, the latter probably owi their origin to littoral sedimentation. The Norian sea had also encroached on t sedimentation area of the Czerwone Wierchy and Giewont series, as shown dolomite Norian fragments occurring in the Dogger transgression deposits.

In the Chochołowska Valley, marine Norian formations show sedimenta connection with marine Rhaetic and Liassic rocks; in the Czerwone Żlebki the shal conglomeratic Keuper series display sedimentary connections with Rhaetic Tom nowa layers, whereas in the Smytnia Valley Norian dolomites are directly ove

l by Liassic formations. At their base a breccia occurs, built up of enormous cks of yellow Norian dolomites. Higher up, the breccia had sedimented in connec- n with Liassic conglomerate and quartz sandstones. Profiles here show rather ong morphologic differentiation and wide facial change in the Rhaetic strata also the high-Tatric series.

At the site Rzędy near Ciemniak Peak, Bajocian crinoidal limestones rest ectly on Norian dolomites. This suggests a further southerly range of the Norian nsgression than of that of the Liassic. Liassic beds have probably never been posited at all in the Czerwone Wierchy and Giewont series. In the Rzędy section re is slight angular unconformity between Norian and Bajocian beds. Movements l taken place during the Rhaetic, after the sedimentation of the Tomanowa ers, but before that of marine Rhaetic deposits from the Chochołowska Valley. the Czerwone Wierchy and Giewont series, this orogenic phase is responsible the penaccordant position of the Dogger beds on those of the Middle Triassic. rious Dogger stages overlap different horizons of the Middle Triassic. This is ily discernible in the southern slope of Mt. Giewont. The footwall in the Czerwone erchy and Giewont folds being pressed out, the observation of tectonic and se- nentary connections of layers is impeded.

boratory of Dynamic Geology
of the Warsaw University
Warszawa, January 1955

DESCRIPTION OF FIGURES IN THE POLISH TEXT

Fig. 1 (p. 276)

Keuper profile in the higher portion of Smytnia Valley

I Middle Triassic (Ladinian); *II* Carnian; *III* Norian; *IV* Liassic

lolomite-quartz breccias; *2* conglomerates: *w* calcareous, *k* quartzose; *3* siliceous ndstones; *4* calcareous sandstones; *5* clayey shales; *6* dolomites; *7* limestones; *8* dolomites with cherts; *9* sandy limestones with cherts

Pl. I.

— sedimentary contact of Norian dolomites with Liassic sandstones

— Liassic conglomerates close to the contact with Norian dolomites; large fragments of Norian dolomites are also discernible

Pl. II

— rain gullies on Norian dolomites — higher portion of Smytnia Valley

— large blocks of yellow Norian dolomites cemented by sandstones and Liassic conglomerates — ibidem

All photos by Z. J. Kotański

И. ГОНСИОРОВСКИ

ФАУНА АПТИХОВ ИЗ КРИНОИДНОГО ИЗВЕСТНЯКА ТИТОНО-БЕРРИАСА В ОКРЕСТНОСТЯХ ЧОРШТЫНА

(Резюме)

В криноидном известняке чорштынской серии в окрестностях Чорштына опаты, Польша), который седиментационно контактирует с глобигериновыми ями (*2, 3*),* автором найдены 55 экземпляров аптихов в 2 профилях (1 и 2) ижней и средней частях этого известняка, в одном же профиле (3) — в его дней части. Автор определяет их, основываясь на критериях Траута (**9**) как:

Lamellaptychus angulocostatus (Pet.) cf. *f. typ.* Trauth (10 образцов)

Lamellaptychus angulocostatus (Pet.) var. cf. *atlantica* (Henn.) (4 **образца)**

Lamellaptychus angulocostatus (Pet.) var. nov.? (2 образца)

Lamellaptychus angulocostatus (Pet.) var. ind. (6 образца)

Lamellaptychus sp. ind. ex gr. d_2 Trauth (13 образцов)

Lamellaptychus sp. ind. ex gr. *d* Trauth (17 образцов)

Lamellaptychus sp. ind. (по всей вероятности не принадлежащие к группе *d* Траута (3 образца).

Большинство описываемых образцов принадлежит к группе *d* Траута (l. c.), ней же к *L. angulocostatus.*

Как кажется, в исследованных профилях не существовали разницы в веральном распространении чаще находимых ламеллаптихов группы *d* Траута. дует подчеркнуть отсутствие леваптихов в этой фауне.

В профилях 1 и 2 почти непосредственно под самыми нижними слоями ыше упомянутой фауной, названной автором первой, он нашел другую фауну ихов. Эта фауна отличается от первой полным отсутствием *L. angulocostatus* ольшим процентом ламеллаптихов, не входящих в группу *d* Траута. Поэтому вая фауна могла в этих профилях появиться лишь немного ниже тех нижних ев или в них самых, где она была найдена автором. Верхняя граница этой вой фауны ни в одном из профилей не могла быть достоверно установлена, как повыше самых высоких слоев с первой фауной аптихи вообще найдены.

Данные, касающиеся возраста описыванной фауны аптихов, следующие:

1. Вид *L. angulocostatus,* согласно с мнением многих авторов, выступает иная с верхнего титона? — по берриас-баррем. Леваптихи исчезают почти

* Цифры курсивом в скобках относятся к списку литературы в польском сте.

совершенно приблизительно на границе мальма и неокома. Вертикальное распространение группы *d* в пределах описываемой фауны не дифференцировано. В этой группе имеют место некоторые изменения в периоде верхней титон-баррем. Поэтому рассматриваемая в этой работе фауна аптихов может быть представителем только части этого периода. Она весьма скудна в разновидности из группы *d*; это безспорно характеризует мальм, может быть — баррем, в котором наступает исчезание ламеллаптихов. С другой стороны, процент индивидов группы этой фауны очень большой, что, по мнению автора, является характерной чертой неокома. И так, исследуемая фауна либо указывает на переход мальма в неоком, либо же она принадлежит к баррему. Вторую возможность следует исключить, так как эта фауна появляется непосредственно выше верхней границы с фауной характерной для юры, то есть обладающей малым процентом индивидов группы *d*.

2. К. Биркенмайер нашел *Tintinnopsella* cf. *carpathica* (Murg. & Filip.), которая встречается весьма редко, и *Globochaeta alpina* Lomb., которая встречается редко в криноидовом известняке титоно-берриаса окрестностей Чорштына (3). Эти находки совершены повыше нижней части этой породы и в иных профилях, нежели те, из которых происходит фауна аптихов автора. Наличие этих микроорганизмов определяет возраст породы как титон-берриас (cf. *4*).

3. Криноидный известняк титоно-берриаса залегает повыше пород с титонской или нижне-титонской фауной. Из сопоставления обычно неточной локализации этих фаун в монографии Улига (*10*) с описанием профилей К. Биркенмайера (*3*) не следует, чтобы эти фауны происходили из пород залегающих непосредственно ниже криноидного известняка титоно-берриаса. Выше, но не непосредственно выше этого известняка, залегают породы, которые вне чорштынской серии в клипповом поясе появляются несомненно в неокоме. Еще выше — во всех сериях клиппового пояса — залегают ценоманские слои с *Rotalipora apenninica* (Renz).

Все эти данные приводят к заключению, что наиболее правдоподобным возрастом исследуемой фауны аптихов является берриас.

I. GĄSIOROWSKI

FAUNA OF APTYCHI FROM THE CRINOIDAL LIMESTONE OF THE TITHONIAN-BERRIASIAN NEAR CZORSZTYN (PIENINY KLIPPEN-BELT)

(Summary)

STRACT: The author describes the fauna of Lamellaptychi from the crinoidal estone which forms the highest part of the so-called Tithonian of some types he Czorsztyn series (Pieniny Klippen-belt). This fauna is characterized by a high entage of individuals from Trauth's group *d* and by a low number of different forms within this group. Its age is most probably Berriasian.

There are several post-Kimmeridgian crinoidal limestones in the Czorsztyn es. They differ in their stratigraphic position *(1, 10)* *. Only one lies directly below *Globigerina* beds. It has been called the Crinoidal Limestone of the Tithonian-riasian *(2, 3)*.

I found 54 specimens of Aptychi [1] in three profiles of the Crinoidal Limestone the Tithonian-Berriasian near Czorsztyn. On Trauth's *(9)* criteria I classify n as:

Lamellaptychus angulocostatus (Pet.) cf. *f. typ.* Trauth — 10 specimens
Lamellaptychus angulocostatus (Pet.) var. cf. *atlantica* (Henn.) — 4 specimens
Lamellaptychus angulocostatus (Pet.) var. nov.? — 2 specimens
Lamellaptychus angulocostatus (Pet.) var. ind. — 6 specimens
Lamellaptychus sp. ind. ex gr. d_2 Trauth — 13 specimens
Lamellaptychus sp. ind. ex gr. *d* Trauth — 17 specimens
Lamellaptychus sp. ind. (probably not belonging to Trauth's group *d*) — 3 speens.

The convex surface of the *L. angulocostatus* (Pet.) var. nov.? differs from the vex surface of the *L. angulocostatus* (Pet.) var. *atlantica* (Henn.) only in the width he lamellae and the corresponding furrows, and from the convex surface of the *ngulo-didayi* Trauth in the complete lack of undulations of the lamellae. *L. anocostatus* (Pet.) var. nov.? may be placed between *L. angulocostatus* (Pet.) *f. typ.* ıth and *L. diday* (Coqu.) in the same way as *L. angulocostatus* (Pet.) var. *ntica* (Henn.) may be placed between *L. angulocostatus* (Pet.) *f. typ.* Trauth and

* Figures in *italics* in brackets refer to literature quoted at the end of the sh text.

[1] Symmetrical pairs of shells when found have been counted as single cimens.

L. seranonis (Coqu.) *f. typ.* Trauth. I do not, of course, mean evolutionary sequen but only sequences of geometrical forms which constitute a passage betw two distinctly different forms. As can be seen from the above list, the major of specimens of Aptychi from the Crinoidal Limestone of the Tithonian-Berrias belong to Trauth's group *d*. Within this group at least an important part of t specimens belongs to *L. angulocostatus*. There are, however, reasons to suppose th in the described fauna the percentage of individuals belonging to group *d* is actua smaller, though not much, than the percentage which could be inferred from n list. In all the profiles of this crinoidal limestone Lamellaptychi belonging to group (excl. of *L. angulocostatus* (Pet.) var. nov.?) appear to occur always together. As the remaining Lamellaptychi, specimens are too scarce to allow an analogous co clusion. Laevaptychi were absent in all the profiles studied by me.

In two profiles of the here studied crinoidal limestone, almost directly und the lowest strata in which I found the above described fauna, I observed a su stantially different fauna of Aptychi. In this fauna *L. angulocostatus* seems to absent and the percentage of Lamellaptychi not belonging to group *d* appears to nearly as high as that of Lamellaptychi belonging to group *d* in the former faun Therefore, the former fauna must have appeared in these profiles either just und the lowest strata by which it was yielded or within these strata. As to the upp limit of the former fauna, no such inference is possible as I observed no Apty in all the profiles of the crinoidal limestone studied by me above the highest stra where it was collected.

Three groups of data as to the age of the described fauna are available. T first is supplied by the fauna itself, the second — by microorganisms found in t Crinoidal Limestone of the Tithonian-Berriasian by K. Birkenmajer *(3)*, and t third — by the stratigraphical position of this limestone.

1° The species *L. angulocostatus* appears perhaps in the Upper Tithonian b more probably in the Berriasian and is found up to the Barremian[2]. Too litt is known about the vertical distribution of the varieties of *L. angulocostatus* to justi their use here, the more so as my determinations are only „cf". Laevapt chi almost completely disappear about the upper limit of Malm (cf. Trauth, I think that the general character of the fauna of Aptychi from the Crinoidal Lim stone of the Tithonian-Berriasian permits to determine its age more exactly tha as Upper Tithonian?-Berriasian-Barremian. As group *d* in this fauna is vertically u differentiated, and as it changes during the Upper Tithonian-Barremian period (

[2] Cf. Trauth, *9*, p. 204-212; Trauth *in* Pires Soares, *5*, p. 54; Glangeaud *in* Pir Soares, *5*, p. 76-77; Andrusov, *1*, pp. 49, 73, 76; Uhlig, *10*, pp. 212-213, 80; *L. angul costatus* has not been found in the undoubtedly Tithonian faunas from the Pieni Klippen-belt. As these faunas are very abundant and rather well known (cf. Andr sov, *1*, Uhlig, *10*), it can be definitely stated that this Aptychus is absent from the But it should be remembered that in the Pieniny Klippen-belt no fauna is know of undoubtedly highest-Tithonian age, although we know few faunas of Upp Tithonian age.

ıuth, 9), this fauna can represent but a part of this period. The fauna in question ˈery poor in varieties from Trauth's group *d*; this is certainly a characteristic of Malm (cf. Trauth, 9) and also, perhaps, of the period of disappearance of Lallaptychi, i. e. the Barremian. On the other hand, the percentage of individuals m group *d* is high in this fauna; in my opinion, this is a characteristic of the ocomian [3].

Therefore, the fauna of Aptychi from the Crinoidal Limestone of the Tithonian-rriasian represents either the transition from the Malm to the Neocomian or the remian. The latter possibility must be excluded, as this fauna almost directly ceeds a fauna which shows a feature characteristic of the Jurassic, i. e. a low centage of individuals from group *d*.

2° K. Birkenmajer found *Tintinnopsella* cf. *carpathica* (Murg. & Filip.) which ˈery rare, and *Globochaete alpina* Lomb. — rare, in the Crinoidal Limestone of Tithonian-Berriasian near Czorsztyn in other profiles than those which yielded fauna *(3)*. These microorganisms determine its age as Tithonian-Berriasian (cf. 4).

3° The Crinoidal Limestone of the Tithonian-Berriasian lies above some ks where Lower Tithonian or Tithonian faunas have been found. The localization these faunas in Uhlig's monograph *(10)* is rather inexact. It is impossible to ascerı whether, or not, some of these faunas had been found directly below the ıtioned limestone, but the latter seems more probable. Above the Crinoidal ıestone of the Tithonian-Berriasian — though not directly — lie rocks that loubtedly begin in the Neocomian within the so-called Transitional Series and hin the Pieniny Series *(2, 3)*. There probably has been a diachronism, but if so. s not known how great it was. In all series of the Pieniny Klippen-belt these ks are succeeded by Cenomanian beds with *Rotalipora apenninica* (Renz) *(2, 3)*.

I think that these data must lead to the conclusion that the fauna of Aptychi m the Crinoidal Limestone of the Tithonian-Berriasian near Czorsztyn is most bably of Berriasian age.

I wish to tender my thanks to Professor F. Bieda, Mr. K. Birkenmajer and Prosor W. Krach, who have been so kind as to discuss with me some points conted with the present paper. I am also greatly indebted to Mr. K. Birkenmajer enabling me to read his unpublished materials on the stratigraphy of the Czorm Series, and to Dr. J. M. Pires Soares of Lisbon for his exquisite courtesy in ding me his important works on Aptychi.

oratory of Geology & Stratigraphy
f the Polish Academy of Sciences
Kraków, December 1955

[3] In literature there are no exact data on the percentage of individuals of ious Aptychi in faunas of various age. In about one thousand specimens of Lallaptychi from the Malm of the Pieniny Klippen-belt collected by me, only a few ong to group *d*. In some fifty specimens from the the Valanginian-Barremian of so-called Transitional Series, the distinct majority belong to group *d*.

DESCRIPTION OF FIGURES IN THE POLISH TEXT

Fig. 1 (p. 292)

Shell of an *Aptychus*

S symphysal rim, *Z* outer rim, *L* lateral rim, *pa* apical diagonal, *a* apex, *l* length after Trauth, 7, fig. 1

Fig. 1 (p. 292)

Schematic section of shell of an *Aptychus* normal to symphysal rim *zs* symphysal slope

Pl. I

Lamellaptychus angulocostatus (Pet.) cf. *f. typ.* Trauth

1 — Convex surface of shell — Czorsztyn, cliff W of the Castle; Crinoidal Limestone of the Tithonian-Berriasian, a loose fragment ×

2 — Ditto, 470 cm. from the upper contact ×

Lamellaptychus angulocostatus (Pet.) var. cf. *atlantica* (Henn.)

3 — Convex surface of shell — „Łysa Skała" cliff SW of Falsztyn; Crinoidal Limestone of the Tithonian-Berriasian, 575 cm. from the upper contact ×

4 — Impression of the convex surface of shell, „Zielone Skały" cliffs between Czorsztyn and Falsztyn; Crinoidal Limestone of the Tithonian-Berriasian, 390 cm. from the upper contact ×

Lamellaptychus angulocostatus (Pet.) var. nov.?

5 — Convex surface of shell — Czorsztyn, cliff W of the Castle; Crinoidal Limestone of the Tithonian-Berriasian, 390 cm. from the upper contact ×

АЛЕКСАНДРОВИЧ & В. ПАРАХОНЯК

ОЦЕНОВЫЕ ТУФФИТЫ ИЗ ОКРЕСТНОСТЕЙ ПИНЧОВА НАД Р. НИДОЙ

(Резюме)

Описаны осадки нижнего тортона окрестностей деревни Кржижановице ке Пинчова и выступающие в этих осадках туффиты. Тортонские осадки ажены здесь гипсами, мергелистыми глинами и мергелями, залегающими на ых мергелях кампана. В нижней части обнажения (рис. 2, стр. 305 польского та) найдено Pectinidae и богатую фауну фораминифер (стр. 315 польского та). Характерной чертой этой микрофауны является наличие многочисленных дставителей семейства Lagenidae и планктоновых фораминифер (пл. I, фот. 1). логичные комплексы фораминифер выступают у подошвы т. наз. барановских в в окрестностях Мехова (пл. II, фот. 1), у подошвы глин с *Ostrea cochlear* срестностях Кракова и у подошвы тортонских глин, выступающих в Верхней езии и в окрестности Остравы (M. Vašiček, *27, 28*,* B. Ružička & K. eš, *20*). В верхней части профиля комплекс фораминифер отчетливо изнется. Здесь выступают многочисленные булимины и увигерины (перечисле- в польском тексте, стр. 316, и пл. I, фот. 2). Этот комплекс в общем хорошо ветствует микрофауне т. наз. ходеницких слоев окрестностей Бохни (*15*). ижней части исследованного профиля (рис. 2, образец 3; таб. 2 и рис. 3) поются многочисленные кристаллы гипса и одновременно фораминиферовая на резко беднеет. Тоже в верхней части профиля в осадках появляется знаельное количество гипса. Можно предполагать, что во время отложения глин ергелей, обнаруженных в местности Кржижановице, осаждение гипса из мор- й воды произошло двоекратно. Залегающие повыше глин гипсы в верхней и обнажения можно считать стратиграфическим эквивалентом гипсов окрестей Мехова, Кракова и гипсов Подолии.

Основываясь на определенном местонахождении глин и мергелей в разах и составе микрофауны фораминифер, авторы причисляют эти породы ерхней части нижнего тортона (= барановские слои по Я. Чарноцкому, *2, 3*).

В мергелях и мергелистых нижне-тортонских глинах, обнаженных в выз в местности Кржижановице, найдены три прослойки породы пирокластичео состава. Порода нижней прослойки (рис. 2-C) не отличается ничем от ужающих ее мергелей и только путем промывки констатировано наличие пигластических зерен кварца и биотита.

* Цифры курсивом в скобках относятся к списку литературы в польском сте.

В породах верхних прослоек (рис. 2-А и 2-В) после удаления фрак меньше чем 3 микрона, остались многочисленные мелкие обломки вулкани ского стекла (пл. II, фот. 2 и 3), пластинки биотита и тяжелые минералы.

Обе прослойки проявляют весьма большую способность обесцвечиван термический анализ обнаружил весьма большое количество монтмориллон (прослойка А — **58,45%**, прослойка В — **61,74%**).

Породы обеих исследованных прослоек определены как сильно бентонити рованные туффиты. Возраст их по всей вероятности соответствует возрасту ту фитов из ходеницких слоев окрестности Бохни (верхняя часть нижнего тортон

ALEXANDROWICZ & W. PARACHONIAK

MIOCENE TUFFITES IN THE VICINITY OF PINCZÓW ON THE NIDA-RIVER

(Summary)

STRACT: Inclusions of bentonitized tuffites were detected in 1953 at Krzyżanoe near Pinczów, to the south of the Holy Cross Mts. associated with marly-argilous Tortonian deposits. A detailed description is here given of the profile of se Miocene deposits from Krzyżanowice, based on the investigated Miocene microna occurring there, also some notes on the petrography of the discovered tuffogenic products.

Geological part

(by S. Alexandrowicz)

In a rockbed of Miocene deposits in the vicinity of Krzyżanowice (fig. 1-K) te *Inoceramus* marls occur yielding an abundant foraminiferal fauna, indicative he Campanian age (see p. 306 of the Polish text).

The Miocene deposits outcropping in a road-cutting (fig. 1-M) are here resented by marls, marly clays and gypsum. Light grey marls with a pelecypods na *(Ostrea; Pecten)* lie in the lower part of the exposure. Higher up they grade marly clays containing a poor fauna. They are overlaid by gypsum rocks. Two intercalations of bentonitized tuffites, ranging from four to eight cm. in thicks, occur in these marly-argillaceous deposits.

The lower part of the profile (sample 2) has yielded idiomorphic quartz crystals xagonal bipyramid), sharp-edged grains of quartz and numerous biotite scales. quartz grains show no signs of mechanic abrasion. They resemble crystals and rtz grain encountered in some tuffite intercalations in the neighbourhood of cow. The grains may, therefore, be of pyroclastic origin, while their occurrence ifies to the presence near Krzyżanowice of the third, lowest tuffite intercalation s. 2-C, 5-C).

The profile of the Krzyżanowice marls shows variations in the numerical ndance of the foraminiferal and molluscan faunas and in the content of glauco-, quartz, pyrite and gypsum of the deposits (see table 2). There is a marked rease in the content of gypsum in the lower part of the profile (sample 3) together h a corresponding impoverishment of the foraminiferal fauna.

A study has been made of the foraminiferal microfauna yielded by samples lected in the road-cutting at Krzyżanowice. Their full list mentions 118 species p. 312-314 of the Polish text). Two foraminiferal assemblages were differentiated

in the profile. The lower (sample 1 & 2) is characterised by an extremely abund microfauna. Representatives of the family Lagenidae and planctonic foramini predominate (see p. 315, and pl. I, fig. 1). This assemblage resembles the „ba orbulinetum" from the vicinity of Ostrava (M. Vasiček *27, 28,* B. Ružička a K. Beneš, *20*), also the „Lanzendorfian fauna" from the neighbourhood of Vien (Grill, *6*) and assemblages occurring at the bottom of clays near Cracow, w *Ostrea cochlear* (pl. II, fig. 1).

The other „Upper" foraminiferal assemblage, containing great numbers buliminae and uvigerinae, is encountered in the higher part of the profile (samp 4-7, p. 316 of the Polish text). This assemblage is similar to those from sub-gyps clays of Upper Silesia and those from the Chodenice beds in the vicinity of Bo nia *(15).*

On grounds of lithological analogies, of their position beneath the gypsum ro and of their foraminiferal fauna, it was possible to establish the age of marls a marly clays from Krzyżanowice. These formations have been referred to the up part of the Lower Tortonian as equivalents of the so-called Baranów beds or su gypsum marls (J. Czarnocki *1, 3, 4* and K. Kowalewski *10, 11, 12*).

The upper tuffite intercalations (A, perhaps also B) of the profile from Kr żanowice may thus be regarded as corresponding to the tuffites of the Choden beds near Bochnia, described by W. Parachoniak *(19).*

Several sites of occurrence of tuffogenic products have now been recor from the Tortonian of the southern margin of the Holy Cross Mts. Two of these s have been reported by J. Samsonowicz *(21).* In the vicinity of Pińczów these produ have been recorded from three sites (fig. 4). In addition to the Krzyżanowice e posure here considered, Miocene bentonites intercalate Tortonian marly clays in neighbourhood of Chmielnik. At Kije, a bentonite intercalation is recorded fr Lower Tortonian clays, which, according to W. Krach, are equivalent to the B ranów beds.

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Kraków, February 1956

Petrographic part
(by W. Parachoniak)

The petrology of bentonitized tuffite intercalations from the Krzyżanow profile has been closely studied. In microscopic thin slides biotite scales, qua grains and heavy as well as opaque minerals were discernible against a backgrou of bentonitized vitreous mass.

After washing off the under-three-microne-grain fraction, powdered sli were prepared which showed the predominance in both samples of grains of devit

ed glass. Unaltered, optically isotropic grains are the exception (pl. II, fig. 2). The
obsidian, pumice and globular varieties of glass were detectable in some grains
(pl. II, fig. 2).

The mineral norms (mineralogical composition) and heavy mineral assemblages of the two tuffite intercalations are as follows:

Mineral norms

	Sample A	Sample B
Glass (devitrified)	82% of volume	83% of volume
Quartz	4	4
Felspars	7	7
Biotite	4	3
Opaque & heavy minerals	4	3

Heavy minerals assemblages

	Sample A	Sample B
Biotite	78.4%	48.0%
Garnet	6.0	18.0
Zircon	4.0	9.3
Tourmaline	0.3	2.7
Topaz	0.3	0.7
Rutile	—	0.7
Glauconite	—	3.3
Opaque minerals	11.0	17.3

Decolouration analyses of methyl blue water solution indicate a high degree of bentonitization experienced by the two tuffite intercalations. Thermic analysis alone after J. Tokarski's method *(23, 24)* shows a relatively high montmorillonite content in the A and B intercalations: 58.45 and 61.74 percent respectively. These two intercalations have been called bentonitized tuffites. It may be noted that amphibole is absent from the heavy minerals here, as it is also from tuffites of the Chodenice beds in the vicinity of Bochnia (W. Parachoniak, *19*). The age of the described tuffite intercalations from Krzyżanowice has been referred to the higher part of the Lower Tortonian.

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College of Mining & Metallurgy
Kraków, January 1956

DESCRIPTION OF FIGURES IN THE POLISH TEXT

Fig. 1 (p. 304)

Sketch map of the area around Krzyżanowice

K outcrop of Cretaceous marls; *M* cutting with exposed Lower Tortonian deposits

Fig. 2 (p. 305)

Outcrop in roadcut near Krzyżanowice

a marls; *b* clayey marls; *c* marly clays; *d* gypsum; *e* intercalations of bentonitized tuffite (*A*, *B*; lower intercalation *C* with pyroclastic material); *f* *1-7* sites of collection of microfaunal samples

Fig. 3 (p. 308)

Quantitative diagram of the occurrence of gypsum, glauconite and foraminifers in the Krzyżanowice profile

gypsum — thick interrupted line; *glauconite* — thin interrupted line; *foraminifers* — dotted line

Fig. 4 (p. 310)

Map of the area around Pińczów

showing occurrence of Tortonian tuffogenic rocks *(T)*

Fig. 5 (p. 311)

Stratigraphic profile of Lower Tortonian deposits from Krzyżanowice

A, *B*, *C*, intercalations of tuffogenic rocks; *g* lamina enriched in gypsum

Pl. I

1 — Lower foraminiferal assemblage from cutting in Krzyżanowice (sample no. 2) ca. × 10

2 — Higher foraminiferal assemblage from cutting near Krzyżanowice (sample no. 3) ca. × 10

Pl. II

1 — Foraminiferal assemblage from base of Baranowice beds in Racławice near Miechów ca. × 10

2 — Fragment of volcanic glass, pumice variety ca. × 250

3 — Fragment of volcanic glass with crystallites ca. × 180

Photos 2 and 3 by B. Ostrowicki

БАРЧЫК

ПЕЩЕРНЫЕ ПИЗОЛИТЫ В ОДНОЙ ИЗ ПЕЩЕР В ВОЙЦЕШОВЕ

(Резюме)

В местности Войцешув в Качавских Горах (Судеты) найдены в пещере, разованной в нижне-кембрийских известняках, в небольшом углублении, на- лненным водой, свободно лежащие пещерные пизолиты. Формой они весьма знородны: шарообразные, цилиндрические, иногда нерегулярные. Величина их леблется от 0,7 до 1,6 см. Окраска их ржаво-желтая. Они очень легкие, их ьемный вес 1,442 г/см³, тогда как объемный вес натеков в этой пещере — 55 г/см³. Пизолиты образованы 15 до 20 концентрическими тонкими слоями рбоната кальция. Ядра их состоят преимущественно из фрагментов известковых геков. По мнению автора процесс образования пещерных пизолитов происхо- г следующим образом. Вода, содержащая H_2CO_3 и $CaCO_3$, капает со свода на э пещеры, образуя небольшие нерегулярные углубления, наполненные водой. пли, падая в углубление, вызывают волнение собранной воды и движение эх погруженных в ней, но свободно лежащих обломков пород. Карбонат каль- я концентрически осаждается на движущихся скальных фрагментах, образуя щерные пизолиты.

W. BARCZYK

ON CAVE PISOLITHS FROM WOJCIESZÓW (POLISH SUDETEN)

(Summary)

Cave pisoliths have been discovered, locally lying in a small water-filled hol inside one of the Lower Cambrian limestone caverns of Wojcieszów, within th mountains Góry Kaczawskie (German: Bober-Katzbach Gebirge), Polish Sudeter Their shape is markedly differentiated and varies from spherical to cylindrical an even irregular contours, with size ranging from 0.7 to 1.6 cm. They are rusty-yellov in colour, very light, their streaks being 1.442 g/cm³ as against 2.355 g/cm³ shown b other infiltrations. The pisoliths are made up of from 15 to 20 concentric calciu carbonate laminae, while their nuclei consist mostly of fragments of stalactites.

The writer accounts as follows for the origin of the pisoliths. Action of wate with a H_2CO_3 and $CaCO_3$ content, dripping down onto the cave floor, wore o small irregularly shaped, water filled hollows. Water of these reservoirs and loo rock fragments there were moved about by drops of water falling down. The pre cipitated calcium carbonate was concentrically deposited on the moved rock frag ments giving rise to cave pisoliths.

Laboratory of Dynamic Geology
of the Warsaw University
Warszawa, February 1956

DESCRIPTION OF FIGURES IN THE POLISH TEXT

Fig. 1 (p. 329)

Cross section of the end of the cave at Wojcieszów where pisoliths were collecte *a* limestones, *b* debris, *c* water filled holes, *d* calcareous cover, *e* hole with pisolith

Fig. 2 (p. 329)

Cross section of depression containing pisoliths
a debris, *b* calcareous cover, *c* water surface, *d* pisoliths

Pl. I

1 — Pisoliths from the cave at Wojcieszów
2 — Cross section of same